IN THE UNITED STATES
PATENT AND TRADEMARK OFFICE

Patent Application
Inventor(s) Vasyl' V. Kozoriz
Case 1
Title Super Conductive Bearing

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Box Patent Application, Assistant Commissioner of Patents, Washington, D. C. 20231 AUG 30 2000
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Dwight A. Marshall AUG 30 2000
Print Name Date

Dwight A Marshall
Signature

BOX PATENT APPLICATION
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SIR:

Enclosed are the following papers relating to the above-named application for patent;

- Specification – 26 pages
- Informal drawings – 13 pages
- Declaration and Power of Attorney
- Small Entity Status Verified Statement
- Information Disclosure Statement
- Affidavit
- Petitions
- Assignment Agreement

CLAIMS AS FILED				
	NO. FILED	NO. EXTRA	RATE	CALCULATIONS
Total Claims	36 - 20= 16	16	x $9	$144
Independent Claims	17 - 3	15	x $39	$585
Multiple Dependent Claim(s), If Applicable	[None]			$0
Basic Fee				$345
Petition(s) and Recording Fee For Assignment(s)				$170
			TOTAL FEE	$1244

Please file the enclosed application. A certified check is enclosed in the amount of $1244 to cover the $345 filing fee, 16 claims in excess of twenty, 15 independent claims in excess of 3, petition and assignment recording fee. Triplicate copies of this letter are enclosed.

Please address all correspondence to **Dwight A. Marshall, 1159 Blind Brook Dr., Worthington, OH, 43235-1206.** Telephone calls should be made to me at Area Code (614)-888-6533.

Respectfully submitted

By Dwight A Marshall
Attorney for Applicant(s), Reg. No. 25896
(614)-888-6533

Date: AUG 29 2000

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

PATENT APPLICATION

Vasyl' V. Kozoriz

CASE 1

TITLE Super Conductive Bearing

ASSISTANT COMMISSIONER FOR PATENTS
WASHINGTON, D.C., 20231

SIR:

PETITION TO FILE PATENT APPLICATION WHERE INVENTOR REFUSES TO EXECUTE APPLICATION PAPERS (37 C.F.R. § 1.47)

1. Petition

Petition is made to have the assignee of the entire interest in the invention entitled Super Conductive Bearing execute the papers in this application for Letters Patent on behalf of the inventor whose has refused to execute the attached application for patent.:

2. Statement

Walter Reiner, by attached Affidavit, says that he resides at 9409 Walnut Hull Dr., Genoa Township, Westerville, Ohio, 43082, that he is the owner of the company Global Trading & Technology, Inc., 5030 Westerville Road, in the city of Columbus, Ohio, 43231. He further says that his company has a duly executed contract, a copy of which is included in this application for patent for recordation in the United States Patent Office, with the inventor of the invention, Super Conductive Bearing, and who is herein identified as Vasyl' V. Kozoriz, reported as residing at 5 Poljarna Street, Apartment 99, in the city of Kyvi (Kiev) 201, in the country of Ukraine, wherein the invention and all the proprietary rights thereto have been duly assigned in the entirety to his company , Global Trading & Technology, Inc. He further says that the inventor has refused to execute the papers required for the filing of a patent application duly assigned by contract to his company, Global Trading & Technology, Inc.

3. Filing of Application

Walter Reiner, owner of the assignee company having assignee rights in the invention, Super Conductive Bearing, hereby petitions the Commissioner of the Patent and Trademark Office for the right to make application for Letters Patent for the invention, Super Conductive Bearing, and to execute the necessary papers on behalf of the inventor who has refused to execute the enclosed application and returned to the Ukraine in order to preserve the rights of the assignee company and to prevent irreparable damage.

4. Affidavit

Walter Reiner has included an attached affidavit giving proof of the pertinent facts and the last known address of the inventor who has left the United States.

2. Fee

The file of $130 is included with the filing of the application for Letters Patent.

Walter Reiner

Signature

AUG 29 2000

Date

Walter Reiner, Owner
Global Trading & Technology, Inc. Assignee of entire interest
5030 Westerville Road
Columbus, OH 43231

Attachment:

Affidavit

IN THE UNITED STATES
PATENT AND TRADEMARK OFFICE

PATENT APPLICATION

Vasyl' V. Kozoriz

CASE 1

TITLE Super Conductive Bearing

ASSISTANT COMMISSIONER FOR PATENTS
WASHINGTON, D.C., 20231

SIR:

VERIFIED STATEMENT CLAIMING SMALL ENTITY STATUS
(37 CFR 1.9(f) & 1.27(c)) SMALL BUSINESS CONCERN

I hereby state that I am

[X] the owner of the small business concern identified below:

[ ] an official of the small business concern empowered to act on behalf of the concern identified below:

Global Trading & Technology, Inc.
5030 Westerville Road
Columbus, OH 43231

I hereby state that the above identified small business concern qualifies as a small business concern, as defined in 13 CFR 121.12, and reproduced in 37 CFR 1.9(d), for purposes of paying reduced fees to the United States Patent and Trademark Office under Sections 41(a) and (b) of Title 35, United States Code, in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons. For purposes of this statement, (1) the number of employees of the business concern is the average over the previous fiscal year of the concern of the persons employed on a full-time, part-time or temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other when either, directly or indirectly, one concern controls or has the power to control the other, or a third-party or parties controls or has the power to control both.

I hereby state that rights under contract or law have been conveyed to, and remain with, the small business concern identified above, with regard to the invention described in

[X] the specification filed herewith, with title as listed above.

[ ] the application identified above.

[ ] the patent identified above.

If the rights held by the above-identified small business concern are not exclusive, each individual, concern or organization having rights in the invention is listed below and no rights to the invention are held by any person, other than the inventor, who would not qualify as an independent inventor under 37 CFR 1.9(c), if that person made the invention, or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).

Each such person, concern or organization having any rights in the invention is listed below:

No such person, concern, or organization exists

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small business entity is no longer appropriate. (37 CFR 1.28(b))

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

Name of Person Signing Walter Reiner

Title of Person if Other Than Owner

Address of Person Signing Global Trading & Technology, Inc.

5030 Westerville Road

Columbus, OH 43231

(614)-882-0800

Signature Walter G. Reiner

Date AUG 29 2000

SUPER CONDUCTIVE BEARING

Field of the Invention

The invention relates to superconductive bearings and in particular to a method and apparatus of operating a structure of a rotor in an equilibrium stable state within a stator by use of superconductive bearings.

Background of the Invention

Bearings have found a widespread use through-out time to enable movement of one mechanical part with respect to another. In one application, a bearing structure may enable movement of a wheel with respect to a axis in which a rotary part such as a wagon wheel rotates around a stationary part such as the wagon axle. In another application, rotating apparatus such as a rotor is positioned within stationary apparatus such as a stator like as in various types of electric motors so that the rotor rotates within the stator. In prior art bearing structures, the constant and long term rotation of a rotating part with respect to a stationary part causes an undue amount of wear on parts of the rotor and stator that are in movable contact with each other and thereby may result in an uneven movement of one part with another and even failure of the bearing structures.

Various techniques have been used to lessen and even prevent the wear of the moving parts. Even in very early times the wear problem was recognized and various types of lubricants have been applied as a thin film between the rotating parts to reduce friction, heat and wear. In addition, it was recognized that various types of materials could be developed and used with new lubricants to reduce the wear of the bearing parts and to improve operation of the bearing structures.

Attempts have also been made to suspend a moving part independently of a stationary part so as to prevent one part from engaging another and thereby reduce friction, wear and heat. Permanent magnets have been used in past bearing structures to generate opposing magnetic flux fields between a housing and an inner rotating member to repulse one moving part from another. In one such bearing structure, various configured iron rings were alternately mounted with axially magnetized rings

on both a rotor and stator in which like poles on and between the rotor and stator face one and another to provide repulsion between the rotor and stator. A problem arises in this arrangement due to the unevenness in the fields generated by minor differences occurring in the ring configurations. One solution to prevent the minor differences from occurring was to install alternate iron rings and radially polarized magnets on both the rotor and stator. In another application, magnets were provided on a bearing rotor and a pair of coils were installed on a stator and pulsed to avoid a vibrational resonance condition between the stator and rotor. Another application, was to make a rotor operate independently of the stator by having one set of rings generating an axially aligned field and another set of rings generating a radially aligned field such that one member was suspended within another without contact. Again, problems exist in these designs due to the inconsistencies in the magnetized members.

Various bearing apparatus in the prior art have been designed to use superconducting material to improve operation of a rotor within fixed stators. In one design, a superconducting rotor is constructed with a magnetic pole at each end of the rotor with the poles resting in a bearing. A bath cools the apparatus such that the rotor is elevated with respect to the fixed bearing. Superconducting coils have been used with both rotor and stator apparatus to develop a repulsive force between the fixed stator and a movable rotor. Methods have been developed for charging superconductive coils constructed of niobiumtitanium and niobium-tin materials submerged in a cooling agent. Thermocouples, one located outside the cooling agent and another located in the cooling agent, are wired in series with the coil and serve to provide a current. One particular bearing structure has circular superconductive coils mounted within a disk of the rotor and has fixed superconductive coils mounted within the stator in a plane parallel to a plane of the rotor coils. The stator coils are positioned directly opposite the rotor coils and generate a repulsive force. Apparatus has also been developed to achieve a current circulating circuit in the winding of a superconducting magnet.

Although superconductive bearing apparatus has been developed in the prior art, a problem arises of instability of operation and super conductive bearing

apparatus is needed to reduce magnetic field inhomogeneities which produce vibration between the stator and rotor in superconductive bearings.

Summary of the Invention

It is an object of the invention for a superconductive magnetic bearing structure to support a rotor with respect to the stator in a free stable state.

It is another object of the invention for a superconductive bearing to have a rotor with closed rotor loops each formed of a superconductive material having zero electrical resistance at a temperature below a superconductivity transition temperature.

It is another object of the invention for a superconductive bearing to have closed stator loops formed of the superconductive material and angularly mounted on a stator around the closed rotor loops.

It is another object of the invention for a superconductive bearing to have a rotor with closed rotor loops each formed of a superconductive material having zero electrical resistance at a temperature below a superconductivity transition temperature and a stator enclosing the rotor and having closed stator loops formed of the superconductive material and angularly positioned around one of the closed rotor loops and cooled below the superconductivity transition temperature to establish frozen magnetic linkages between the closed rotor and stator closed loops to form the superconductive bearing supporting a rotation of the rotor in an equilibrium stable state within the stator.

It is another object of the invention for a superconductive bearing to have two-state switches each having resistive and shorting states for use with closed rotor and stator loops for enabling energization of the closed rotor and stator loops to establish frozen magnetic linkages therebetween.

In a preferred embodiment of the invention, apparatus for supporting a rotor with superconducting bearings in a stator has a rotor with a pair of closed rotor loops each formed of a planar short-circuited coil wound of a superconductive wire having zero electrical resistance at a temperature below a superconductivity transition temperature and which are mounted on a shaft of the rotor at each end of the rotor. A stator encloses the rotor and has closed stator loops formed as planar short-circuited coils wound of the superconductive wire and are configured to have two non-equal circular-arc sides joined

at the ends thereof by radial segments and each is angularly positioned at ends of the stator around one of the closed rotor loops. A two-state switch having a resistive and a short state is formed of coils of wire wound around a section of the planar short-circuited coils of the closed stator loops. A cooling agent cools the closed rotor and stator closed loops to a temperature below the superconductivity transition temperature. Apparatus energizes the cooled closed rotor and stator loops and the two-state switch and establishes frozen magnetic linkages between the closed rotor and stator closed loops and forms a superconductive bearing supporting a rotation of the rotor in an equilibrium stable state within the stator. Sensors mounted on the stator within a magnetic field zone of the closed stator and rotor loops frozen magnetic linkages registers linear shifts and angular declinations of the rotor relative to the stator.

In another embodiment of the invention, a planar superconductive bearing structure has a rotatable member formed as a short-circuited coil wound of a superconductive wire having zero electrical resistance at a temperature below a superconductivity transition temperature. A plurality of stationary member closed loops are formed as a planar short-circuited coils wound of the superconductive wire configured to have two non-equal circular-arc sides joined at the ends thereof by radial segments are each angularly positioned around the closed rotatable member. A cooling agent cools the closed rotatable and stationary member closed loops to a temperature below the superconductivity transition temperature. Apparatus energizes the cooled rotatable and stationary member closed loops and establishes frozen magnetic linkages therebetween forming a superconductive bearing supporting a rotation of the rotatable member in an equilibrium stable state within the stationary members.

In another embodiment of the invention, a method of supporting a rotor within a stator by superconducting magnetic bearings comprises a step of arresting the rotor having closed rotor loops with respect to the stator having closed stator loops adjacent the closed rotor loops wherein the closed loops are formed of a superconductive material. The method cools the rotor and stator closed loops to a temperature below a superconductivity transition temperature and establishes a zero

electric resistance of the closed loops. The method enables a small portion of the cooled rotor and the stator closed loops to assume a resistance state and applies a current through the resistance state of the cooled rotor and stator closed loops to generate frozen magnetic linkages between the rotor and stator closed loops. The rotor is then freed to rotate in an equilibrium stable state within the stator.

Brief description of the Drawing

For a further understanding of the objects and advantages of the present invention, reference should be had to the following detailed description, taken in conjunction with the accompanying drawing figures, in which like parts are given like reference numerals and wherein:

Fig. 1 is a view of one embodiment of bearing apparatus in accordance with the principles of the invention,

Fig. 2 illustrates a symbolic representation of the bearing apparatus at room temperature,

Fig. 3 illustrates a two-state switch used in accordance with the bearing apparatus set forth in Fig. 1 and the symbolic bearing apparatus representation of Fig. 2,

Fig. 4 illustrates the symbolic representation of the bearing apparatus in Fig. 2 at a temperature T_1 below a superconductivity transition temperature T_C,

Fig. 5 illustrates the symbolic representation of the bearing apparatus in Fig. 2 with current applied to the closed stator loops,

Fig. 6 illustrates the symbolic representation of the bearing apparatus in Fig. 2 with current removed from the closed stator loops and with two-state switches in the shorting states, respectively.

Fig. 7 illustrates the symbolic representation of the bearing apparatus in Fig. 2 with the rotor freed and with two-state switches in the shorting state and with the rotor positioned in an operational stable state with respect to the stator by frozen magnetic linkages established between the bearings closed stator and rotor loops.

Fig. 8 is a view of another embodiment of bearing apparatus in accordance

with the principles of the invention,

Fig. 9 is a view of still another embodiment of bearing apparatus in accordance with the principles of the invention,

Fig. 10 is a view of yet another embodiment of bearing apparatus in accordance with the principles of the invention, and

Figs. 11 through 19 illustrates various constructions of closed rotor and stator loops in accordance with the principles of the invention.

Detailed Description of the Invention

In a first exemplary embodiment of the invention, superconductive bearing apparatus 10, in accordance with the principles of the invention, is shown in Fig.1 of the drawing. The bearing apparatus 10 set forth in Fig. 1 has two magnetic superconductive magnetic bearing structures rotatably supporting a rotor 200 in a free state within a stator 100. Each bearing structure consists of three closed stator loops 101 and one closed rotor loop 202 wherein the cross section of each loop is small compared to the area of the planer loop. The closed stator loops 101, although not limited thereto, may be planar superconductive short-circuited coils wound from thin niobium-titanium or niobium-tin wire or similar superconductive material and are angularly mounted at ends of the stator around the closed rotor loops 202. Each closed stator loop 101, although not limited thereto, is configured to have two non-equal circular arc sides 1010 joined at the ends thereof by radial segments 1011. Three closed stator loops 101 are mounted in a plane at each end of the stator and are positioned 120^0 apart around a closed rotor loop 202 to form one superconductive bearing. Each closed rotor loop 200 is a planar short-circuited coil wound from thin niobium-titanium or niobium-tin wire or is formed from a similar superconductive material of a superconductive wire and mounted on one end of the rotor shaft 201.

In an initial state, the rotor 200 is prevented from rotation and is held in a fixed position with respect to stator 100 by arresting apparatus. Arresting apparatus may, in one embodiment of the invention, be a cylindrical member 203 having a conical aperture 2030 formed therein to receive a pointed end of rotor shaft 201 and initially hold rotor 200 in a non-rotational and fixed position with regard to stator

100. Other types and configurations of arresting apparatus may be devised within the spirit and scope of the invention to hold and release rotor 200 with respect to stator 100. In operation, cylindrical members 203 located at and engaging each end of the rotor shaft 1000 are moved outward along axis 1000 of rotor shaft 201 and away to disengage the conical apertures 2030 from the ends of rotor shaft 201. Rotor 200, in a manner herein after described in detail, is thereby released to move in a free stable state with regard to stator 100.

In order to prepare the bearing apparatus of Fig. 1 for operation, certain steps must be fulfilled. First rotor 200, Fig. 2, is held relative to stator 100 by the arrester members 203 gripping rotor shaft 201 after movement along axis 1000 while the bearing apparatus components are at room temperature T. When the room temperature T is maintained above the superconductivity transition temperature T_C, the closed stator loops101 are symbolically shown as coils 102u connected to current terminals 152 and 153 with a two state switch 151 shown as connected across ones of the coils 101u. Similarly, each of the two closed rotor loops 202 positioned at an end of the rotor 200 are each symbolically shown as coils 202u coupled with another two state switch 251. The two bearing structures are each represented by the combination of the closed stator loop coils 101u and two-state switch 151 with the closed rotor loop coils 202u and two-state switch 251 located at each end of the rotor 200. At room temperature T, the two-state switches 151 and 251 are represented in a resistance state.

The closed stator loops 101, Fig. 1, of each bearing structure may be connected in series as shown in Fig. 2 with outer ends of one of the closed stator loop coils 101u connected to current terminals 152. Thus, a current may be applied from a current source to one terminal 152 and, at room temperature T, flow through coils 101u of the three closed stator loops 101 and return to the source by the other terminal 152. In one embodiment of the invention, Fig. 3, although not necessarily limited thereto, two-state switch 151 may be constructed of a coil 10u wound around part of a coil winding of ones of the closed stator loop coils 101u and will operate in a

manner hereinafter described in detail to assume states herein represented as a resistance and a short, respectively.

With the rotor 200 held in a fixed positioned with respect to stator 100 by arresting members 203, Fig. 4, the bearing apparatus is cooled by a cooling agent to a temperature T_1 below the superconductivity transition temperature T_C of the closed rotor and stator coil superconductor materials. With the superconductivity material of the closed stator and rotor loops, the resistance decreases as the temperature T_1 decreases and suddenly drops to essentially zero as temperature T_1 drops below the superconductivity transition temperature T_C. The electrical resistance of the closed rotor and stator loops 101, 202, Fig. 1, will remain at the zero value so long as the temperature condition T_1 is less than T_C for all parts of the closed loops. Thus, when temperature T_1 of the bearing apparatus is below the superconductivity transition temperature T_C, the resistance of the closed rotor and stator loop coils 202u and 101u, Fig. 4, is essentially zero and two-state switches 151 of the stator 100 and 251 of the rotor 100 are shown as being in the short state.

As set forth in Fig. 3 of the drawing, a current I_1 is applied to the heating coil 10u of two-state switch 151. The temperature of the section of coil winding 101u surrounded by heating coil 10u rises above the superconductivity transition temperature T_C, Fig. 5, thereby causing the two-state switches 151 to assume the resistive state. Current I is then applied to the bearing apparatus via a current source 160 connected to the terminals 152 of the closed stator loops 101u while the temperature condition T_1 is less than T_C. In accordance with the superconductivity phenomenon, the superconductivity zero resistance of a small portion of the closed stator loops 101u are destroyed by the applied current I. Thus, a closed electrical circuit exists for the flow of an electric current. The applied current I and the flow of the applied current I in the closed stator loops 202u thereby generate a magnetic flux field between the adjacent closed stator and rotor coils 102u and 202u, respectively, attracting the closed rotor coils 202u to the closed stator coils 102u when the rotor coils 202u are positioned with respect to the stator coils 102u. The generated magnetic flux fields generate a current flow in the closed rotor loops 202u.

After achieving desirable energizing levels for the coils 101u of the closed stator loops 101, current I_1, Fig.3, is removed from heating coils 10u to discontinue the heating of the sections of closed stator loop coils 101u and the current I is removed from terminals 152, Fig. 6. Due to the cooling agent that is continuously cooling the bearing apparatus and the shut off of heating coils 10u, the temperature T_1 is less than T_c and the zero electrical conductivity state as a consequence is restored to the closed stator loop coils 101u. The condition of two-state-switches 151 and 251 corresponds to the short state and in accordance with the superconductivity phenomenon the current remains in the closed stator and rotor loops 101 and 202 and they begin to operate in a frozen magnetic linkage mode attracting one to the other without requiring any additional power.

Additional energizing of some of the closed stator loops may be required to provide for the fixed location of the rotor 200 after freeing, if needed. After that all of the closed stator and rotor loops 101 and 202 become short-circuited, Fig.6, the superconductive coils 101u and 202u operate in the frozen magnetic linkage mode with non-zero and non-equal frozen magnetic linkage for any pair of magnetically interacting closed stator and rotor loop 101 and 202. After final energizing of the closed stator and rotor loops 101 and 202, Fig. 1, sensors 300 mounted on the stator 100 measure magnetic fields parameters at fixed location of the rotor 100. With the closed stator and rotor loops 101 and 102 linked by the frozen magnetic linkages of the stator and rotor coils 101u and 201u, Fig. 7, and the two-state switches 151 and 251 in the short state, the arrester members 203 are moved outward along rotor axis 1000 to free rotor shaft 201, Fig. 1, thereby enabling rotor 200 to rotate in a positional equilibrium stable state with respect to stator 100 within the superconductive bearing structures defined by the magnetically linked and closed stator and rotor loops 101 and 202.

After freeing the rotor 200, the sensors 300 register changes of magnetic field parameters and a measuring subsystem that may be connected with the stator sensors 300 determines linear shifts and angular inclinations of the rotor 200 at its free locations compared with its fixed location relative to stator 100. If these shifts and

inclinations surpass acceptable shifts and inclinations , the above steps may be repeated beginning with moving the arrester members 203 along rotor axis 1000 to engage the rotor shaft 201. After the required limitations of shifts and inclinations of the rotor 200 in its free equilibrium location are satisfied, the free rotor 200 may be rotated at various speeds within its operation range. For each rotor speed, additional energizing can be made to limit shifts and declinations for the revolving rotor 200 to acceptable deviations.

Another embodiment of the invention is shown in Fig. 8 of the drawing. The superconductivity bearing apparatus has a number of closed rotor loops 202 each wound as a coil of the superconductive wire or material around the rotor 201 and each positioned in a circular plane about the axis 1000 of the rotor 201 The stator 100 has a number of closed stator loops 101 each wound as a coil of superconductive wire 209 and ones of which are mounted in the stator 100 in a plane around the rotor adjacent to a corresponding one of the closed rotor loops 202. The closed stator loops 101 and rotor loops 202 are positioned in planes perpendicular to the rotor axis 1000 to form an axial plurality. Any pair of this plurality, or each superconductivity bearing, consists of six closed stator loops 101 and one closed rotor loop 202 positioned with the six closed stator loops 101 surrounding the one closed rotor loop 202. Each closed stator loop 101 is a planar superconductive short-circuited coil wound from a thin niobium-titanium or niobium-tin wire 209 or constructed from other super conductive material. Closed stator loops 101 are equipped with the two-state-switch, Fig. 3, and encased in a rigid member mounted on stator 100. The planar closed stator loop 101 is configured by two non-equal circular arcs and two radial segments connected by smooth curves. Six closed stator loops 101 are equally angularly spaced in a plane parallel to the rotor axis 1000 such that each of the six closed stator loops 101 are equally distant from the axis 1000. Each closed rotor loop 202 is a ring superconductive short-circuited coil wound from the thin niobium-titanium or niobium-tin wire 209, or other superconductive material, and equipped with the two-state-switch, and encased in a rigid member which is mounted around the rotor shaft 201. In the structure, each superconductivity bearing

has six of the closed stator loops 101 angularly positioned around one closed rotor loop 202 and are located in the same plane with other superconductivity bearing planes equally spaced along the rotor 201. In order to establish the operating conditions for this superconductivity bearing apparatus, the steps as earlier set forth for Figs. 2 through 7are required.

In another embodiment of the invention, Fig. 9, each closed stator loop101 is an identical coil encased in a rigid member mounted on stator 100 and wound from a thin superconductive niobium-titanium or niobium-tin wire 209 or other superconductive material and equipped with the two-state-switch, Fig. 3. The closed stator loops 101 are each angular spaced and mounted on the stator between ones of the rotor closed loops 202 so as to be perpendicular to and off-center of the rotor axis 1000. Each closed rotor loop 202 is an identical short-circuited coil wound from a thin niobium-titanium or niobium-tin wire 209 or other super conductive material and encased in a rigid member attached to the rotor shaft 201 by a disk 207 positioned along the rotor axis 1000. In the arrested position of the rotor , the closed rotor loops 202 are concentric to the rotor axis 1000 and are equally axially spaced relative to adjacent closed stator loops 101. The operating conditions for this bearing apparatus are similar to the preferable embodiment of Fig. 1. In operation, frozen magnetic linkages are established between adjacent closed stator and rotor loops 101 and 202 thereby supporting a rotation of the rotor 200 in an equilibrium stable and free state within the stator 100.

In yet another embodiment, superconductive bearing apparatus, in accordance with the principles of the invention, has a pair of superconductive magnetic bearings, Fig. 10. Each superconductive magnetic bearing is composed of three planer closed stator loops 101 adjacent one closed rotor loop 202 and may be used with a kinetic energy carrier for flywheel energy storage. The stator 100 comprises a pair of planar closed stator loops each having three coils wound of superconductive thin niobium-titanium or niobium-tin wire or formed of other superconductive material and each coil angularly spaced adjacent to another one of the coils and each of three closed stator loops 101 mounted at an end of the stator

100 in a plane parallel to a corresponding one of the closed rotor loops 202 and each equipped with a two-state-switch, Fig. 3. Each closed stator loop 101 is formed in a circular arc and two radial segments connected by smooth curves configuration and are equally angularly spaced in their plane and from rotor axis 1000. Closed rotor loops 202 are a ring configured superconductive short-circuited coil wound from superconductor wire and encased in a rigid member mounted in a plane perpendicular to the rotor axis 1000 on ends of the rotor 200 adjacent to three of the closed stator loops 101. The procedures for preparing this apparatus for operation are similar to above set forth procedures for the embodiment shown in Fig.1. In operation, frozen magnetic linkages are established between the three adjacent closed stator loops 101 and a closed rotor loop 202 thereby supporting a rotation of the rotor 200 in an equilibrium stable free state within the stator 100.

Closed loops as sources of magnetic fields can be represented in various design configurations. A pair of closed stator and rotor loops for use with a superconductive bearing rotor and stator shown in Fig.11 may be fabricated from a wide range of superconductor material. Generally they form concentric rigid thin current carrying rings 500. Rings 500 are formed in a three-layered plate wherein they are mounted in a heat sink 501 secured to a resistive heater 502 and attached to a backing 503. In another design, Fig. 12, a current carrying configuration is formed of a plurality of closed stator loops 500 each formed of a superconductive material configured to have two non-equal circular-arc sides joined at the ends thereof by radial segments and having zero electrical resistance at a temperature below a superconductivity transition temperature. Closed loops 500 are mounted in a circular configuration in a heat sink 501 which is secured on a resistive heater 502 attached to a backing 503 to form a closed loop network.

Fig. 13 illustrates another concept for the fabrication of closed loops. A thin layer of a resistive heater 502 is deposited on a flat backing 503. Next, a first heat sink 501, a thin layer of a good heat conductor like copper, is deposited on the resistive heater 502. Then a thin film of a semiconductor material such as a niobium-tin is deposited on the flat surface of heat sink 501 which is then etched to form a

pattern of closed current carrying loops 500 as pluralities of individual closed curves and/or a rigid network with meshes of small width loops. After depositing the first layer of loops 500, a second heat sink layer 504 is deposited so that it fills all open areas and covers loops 500 providing a flat surface before next depositing the second layer of closed loops 500. Then a third heat sink layer 504 is deposited similarly to the second one. The layer sequence is repeated to form a "sandwich" of current carrying closed loops of identical or unlike loops and with loop coincidence or not for neighboring layers of closed loops.

In any version of thin film technology, a closed loop 500 intended for mounting on a stator or rotor can be fabricated to include a current carrier, resistive heaters as two-state-switches, and with heat sinks. In one exemplary example, Fig.14, a plurality of closed loops 500, each formed of a superconductive material configured in a square configuration and having zero electrical resistance at a temperature below a superconductivity transition temperature, are formed as a "sandwich" of two webs of closed loops 500 having a square shape positioned in a mesh. First ones of the closed loops 500 are mounted as a square mesh on an upper surface of a first heat sink 504 and second ones of the closed loops 500 are mounted as a square mesh on an upper surface of a second heat sink 501 and mounted such that the second closed loops 500 are positioned adjacent a lower surface of the first heat sink 504 to correspond with the first closed loops 500.

Individual square multiple closed loops 500, Fig. 15, can be placed on heat sink 504 and configured in a micron size for typical micron superconductive bearing applications. The same scaling convention, Figs 16 and 17 may be used to form meshes of square and ring configured closed loops 500 of thin super conductive current carriers deposited on heat sinks 504.

Fig. 17 shows a design of individual ring current carriers 500 deposited on heat sink 504. Small sizes of closed loops in Figs. 15 through 17 promote the high rigidity of the magnetic bearing because rigidity is inversely proportional to sizes of current carriers. Fig. 18 shows large concentric closed rings 501 and small closed rings 500 between the large closed rings 501. Large concentric rings 501 configured

as closed loops are responsible for providing large magnetic forces and small rings 500 are beneficial in providing high rigidity of a magnetic bearing. Fig.19 illustrates two neighboring layers 504 of closed loops 500 which overlap one another. Similar geometric configurations increases rigidity of superconductivity magnetic bearings due to overlapping of closed loops in layers of coils. The closed loop configurations set forth in Figs.15 through 19 may be utilized for the stator and rotor of superconductivity magnetic bearings.

A variety of sizes, forms and displacements of super conductive short-circuited loops can be used for the stator and rotor to provide specific magnetic force interaction in magnetic bearings. The closed loops geometry can satisfy high load requirements by special mutual displacements of magnetically interacting closed loops mounted on the stator and rotor. At the same time these mutual displacements must provide for the required properties of stable positioning and zero torque respective to the axis of the stator only. In other respects they can be arbitrary. Therefore, typical concentric mutual displacement is not necessary. The invention proposes two types of the non-concentricity. In one case the non-concentricity is between axes of the stator and the magnetic field of the closed stator loops and in the second case between the axes of the stator and magnetic fields of the closed rotor loops. The non-concentricity loop arrangement provides for non-zero radial derivative of mutual inductance responsible for high rigidity. The invention also proposes special force regimes for magnetic forces in the superconductivity magnetic bearings in order to stretch or press the free rotor in axial and radial directions. These regimes may be utilized to establish conditions for providing for maximal rigidity of a superconductivity magnetic bearing.

Additional advantages may be achieved by adjustments of locations of the free rotor while it is in equilibrium and rotating to guarantee reliable performance over a range of speeds. Using magnetic field sensors, 300, Fig. 1, and a measuring subsystem, of a type well known and which needs not be shown for an understanding of the invention, can fulfill this adjustment. The sensors 300 are mounted on the stator and positioned in zones of the closed stator loop magnetic fields so that radial shifts

of the rotor and angular declinations of the rotor axis are in functional relations with the sensors data in a one-to-one correspondence. As an example, the sensors 300 are located so that their axes of sensitivities are parallel to the stator axis and the rotor center of mass is between parallel planes containing the sensors 300. The number of sensors 300 positioned in each plane is three or more. Sensor data on the magnetic field parameters in each plane indicate the maximal radial rotor shifts in this plane. Data from sensors 300 in two planes are processed through the measuring subsystem to provide the means for accurate determination of radial shifts of the rotor center of mass and angular declinations.

While the foregoing detailed description has described several embodiments of superconductive bearing apparatus in accordance with this invention, it is to be understood that the above description is merely illustrative and does not limit the scope of the claimed invention. Particularly, the disclosed superconductive bearing apparatus may have various configurations of the stator and rotor in combination with various shapes and configurations of stator and rotor closed loops for establishing magnetic linkages supporting a rotation of the rotor in an equilibrium stable free state within the stator. It is obvious from the foregoing that the facility, economy and efficiency of bearing apparatus may be substantially enhanced by superconductive bearing apparatus for establishing magnetic linkages between closed stator and rotor loops forming a bearing supporting a rotation of the rotor in an equilibrium stable free state within the stator.

What is claimed is:

1. Apparatus for supporting a rotor with respect to a stator comprising

loops formed of a material having zero electrical resistance at a temperature below a superconductivity transition temperature and which are mounted on the rotor,

loops formed of the zero electrical resistance material and angularly mounted on the stator adjacent each of the closed rotor loops,

a cooling agent for cooling the closed rotor and stator closed loops to a temperature below the superconductivity transition temperature, and

apparatus for energizing the cooled closed rotor and stator loops and establishing magnetic linkages therebetween forming a bearing supporting a rotation of the rotor in an equilibrium stable free state within the stator.

2. The bearing apparatus set forth in claim 1 further comprising

sensors mounted on the stator within a magnetic field zone of the stator loops for registering linear shifts and angular declinations of the rotor relative to the stator.

3. The bearing apparatus set forth in claim 2 wherein the rotor loops each comprise

a planar short-circuited coil wound of a superconductive wire and mounted on an end of a shaft of the rotor.

4. The bearing apparatus set forth in claim 3 wherein the stator loops each comprise

a planar short-circuited coil wound of the superconductive wire and angularly positioned at ends of the stator around the closed rotor loops.

5. The bearing apparatus set forth in claim 2 wherein the closed stator loops each comprise

a planar short-circuited coil wound of the superconductive wire configured to have two non-equal circular-arc sides joined at the ends thereof by radial segments.

6. The bearing apparatus set forth in claim 1 wherein the rotor comprises

a plurality of closed rotor loops each wound as a coil of the superconductive wire around the rotor and each positioned in a circular plane about an axis of the rotor.

7. The bearing apparatus set forth in claim 6 wherein the stator comprises

a plurality of closed stator loops each wound as a coil of the superconductive wire and ones of which are mounted in the stator in a plane around the rotor adjacent to a corresponding one of the closed rotor loops.

8. The bearing apparatus set forth in claim 1 wherein the rotor comprises

a plurality of closed rotor loops each wound as a coil of the superconductive wire around the rotor and each mounted on the rotor shaft in adjacent planes each perpendicular to an axis of the rotor.

9. The bearing apparatus set forth in claim 8 wherein the stator comprises

a plurality of closed stator loops each wound as a coil of the superconductive wire and each angular spaced and mounted on the stator between ones of the rotor closed short-circuited loops so as to be off-center of the axis of the rotor.

10. The bearing apparatus set forth in claim 1 wherein the rotor comprises

a pair of closed rotor loops each wound as a coil of the superconductive wire and mounted on an end of a shaft of the rotor in a plane perpendicular to an axis of the rotor shaft.

11. The bearing apparatus set forth in claim 10 wherein the stator comprises

a pair of closed stator loops each having three coils wound of the superconductive wire and each coil angularly spaced adjacent to another one of the coils and wherein each closed stator loop is mounted on an end of the stator in a

plane parallel to a corresponding one of the closed rotor loops.

12. Bearing apparatus comprising

a rotor having a pair of closed rotor loops each formed of a planar short-circuited coil wound of a superconductive wire having zero electrical resistance at a temperature below a superconductivity transition temperature and which are mounted on a shaft of the rotor at each end of the rotor,

a stator enclosing the rotor and having closed stator loops formed as planar short-circuited coils wound of the superconductive wire configured to have two non-equal circular-arc sides joined at the ends thereof by radial segments and each angularly positioned at ends of the stator around the closed rotor loops,

a cooling agent for cooling the closed rotor and stator closed loops to a temperature below the superconductivity transition temperature,

apparatus for energizing the cooled closed rotor and stator loops and establishing magnetic linkages therebetween forming a bearing supporting a rotation of the rotor in an equilibrium stable state within the stator, and

sensors mounted on the stator within a magnetic field zone of the closed stator loops and rotor loops magnetic linkages for registering linear shifts and angular declinations of the rotor relative to the stator.

13. A planar superconductive bearing structure comprising

a rotatable member formed as a short-circuited coil wound of a superconductive wire having zero electrical resistance at a temperature below a superconductivity transition temperature,

a plurality of stationary members each formed as closed loops formed as planar short-circuited coils wound of the superconductive wire configured to have two non-equal circular-arc sides joined at the ends thereof by radial segments and each angularly positioned around the closed rotatable member,

a cooling agent for cooling the closed rotatable and stationary member closed loops to a temperature below the superconductivity transition

temperature, and

apparatus for energizing the cooled rotatable and stationary member closed loops and establishing magnetic linkages therebetween forming a bearing supporting a rotation of the rotatable member in an equilibrium stable free state within the stationary members.

14. Apparatus for supporting a rotor with respect to a stator comprising

a plurality of closed rotor short-circuited loops formed of a material having zero electrical resistance at a temperature below a superconductivity transition temperature and each of which are wound as a coil of wire around the rotor and positioned along the rotor in a circular plane about an axis of the rotor,

a plurality of closed stator loops each wound as a coil of the superconductive wire and each mounted on the stator and each angularly positioned in a plane round the rotor adjacent to a corresponding one of the closed rotor short-circuited loops,

a cooling agent for cooling the closed rotor and stator loops to a temperature below the superconductivity transition temperature, and

apparatus for energizing the cooled closed rotor and stable loops and establishing magnetic linkages therebetween forming a bearing supporting a rotation of the rotor in a stable equilibrium free state within the stator.

15. Apparatus for supporting a rotor with respect to a stator comprising

a rotor having a plurality of closed rotor short-circuited loops each wound as a coil of superconductive wire having zero electrical resistance at a temperature below a superconductivity transition temperature and each mounted on a shaft of the rotor in a plane perpendicular to an axis of the rotor,

a stator enclosing the rotor and having a plurality of closed stator loops each wound as a coil of the superconductive wire and each spaced and mounted on the stator between ones of the rotor closed short-circuited loops so as to be off-center of the rotor axis,

a cooling agent for cooling the closed rotor and stator closed loops to a temperature below the superconductivity transition temperature, and

apparatus for energizing the cooled closed rotor and stator loops and establishing magnetic linkages therebetween forming a bearing supporting a rotation of the rotor in a stable equilibrium free state within the stator.

16. Apparatus for supporting a rotor with respect to a stator comprising

a pair of closed rotor short-circuited loops each wound as a coil of superconductive wire having zero electrical resistance at a temperature below a superconductivity transition temperature and each mounted on an end of a shaft of the rotor in a plane perpendicular to an axis of the rotor,

a pair of planar stator members each having three coils wound of the superconductive wire and each coil angularly spaced adjacent to another one of the coils and wherein the three closed stator coils are mounted on an end of the stator in a plane parallel to and adjacent to a corresponding one of the closed rotor loops,

a cooling agent for cooling the closed rotor and stator closed loops to a temperature below the superconductivity transition temperature, and

apparatus for energizing the cooled closed rotor and stator loops and establishing magnetic linkages therebetween forming a bearing supporting a rotation of the rotor in a stable equilibrium free state within the stator.

17. The supporting apparatus set forth in claim 2 wherein the rotor loops each comprise

a planar superconductive short-circuited coil wound from thin niobium-titanium wire.

18. The supporting apparatus set forth in claim 2 wherein the rotor loops each comprise

a planar superconductive short-circuited coil wound from thin niobium-tin wire.

19. The supporting apparatus set forth in claim 2 wherein the stator loops each comprise

a planar superconductive short-circuited coil wound from thin niobium-titanium wire.

20. The supporting apparatus set forth in claim 2 wherein the stator loops each comprise

a planar superconductive short-circuited coil wound from thin niobium-tin wire.

21. The supporting apparatus set forth in claim 1 wherein ones of said loops comprise

a two-state switch having a resistive and a short state.

22. The supporting apparatus set forth in claim 4 wherein ones of said planar coils comprise

a two-state switch having a resistive and a short state formed of coils of wire wound around a section of the planar short-circuited coils.

23. Apparatus for supporting a rotor with respect to a stator comprising

a rotor having a pair of closed rotor loops each formed of a planar short-circuited coil wound of a superconductive wire having zero electrical resistance at a temperature below a superconductivity transition temperature and which are mounted on a shaft of the rotor at each end of the rotor,

a stator enclosing the rotor and having closed stator loops formed as planar short-circuited coils wound of the superconductive wire configured to have two non-equal circular-arc sides joined at the ends thereof by radial segments and each angularly positioned at ends of the stator around the closed rotor loops,

a two-state switch having a resistive and a short state formed of

coils of wire wound around a section of the planar short-circuited coils of the closed stator loops,

a cooling agent for cooling the closed rotor and stator closed loops to a temperature below the superconductivity transition temperature,

apparatus for energizing the cooled closed rotor and stator loops and the two-state switch and establishing frozen magnetic linkages between the closed rotor and stator closed loops and forming a bearing supporting a rotation of the rotor in an equilibrium stable free state within the stator, and

sensors mounted on the stator within a magnetic field zone of the closed stator loops and rotor loops magnetic linkages for registering linear shifts and angular declinations of the rotor relative to the stator.

24. Rotor and stator superconductive bearing apparatus comprising

a pair of closed loops for use with a superconductive bearing rotor and stator each formed of a superconductive material having zero electrical resistance at a temperature below a superconductivity transition temperature and which are mounted in a heat sink material secured on a resistive heater attached to a backing material.

25. Stator superconductive bearing apparatus comprising

a plurality of closed stator loops each formed of a superconductive material configured to have two non-equal circular-arc sides joined at the ends thereof by radial segments and having zero electrical resistance at a temperature below a superconductivity transition temperature and which are mounted in a circular configuration in a heat sink material secured on a resistive heater attached to a backing material.

26. Superconductive bearing apparatus comprising

a thin layer of a resistive heater deposited on a flat backing,

a heat sink deposited on the resistive heater,

thin films of a superconductive material having zero electrical

resistance at a temperature below a superconductivity transition temperature are deposited in a sandwich configuration on the heat sink and which are etched to form a pattern of closed loops.

27. Superconductive bearing apparatus comprising

a plurality of closed loops each formed of a superconductive material configured in a square configuration and having zero electrical resistance at a temperature below a superconductivity transition temperature and which are mounted in rows and columns on a heat sink disk.

28. Superconductive bearing apparatus comprising

a plurality of closed loops each formed of a superconductive material configured in a square mesh of super thin closed loops and having zero electrical resistance at a temperature below a superconductivity transition temperature and which are mounted in rows and columns on a heat sink disk.

29. Superconductive bearing apparatus comprising

a plurality of closed loops each formed of a superconductive material configured in a circular configuration and having zero electrical resistance at a temperature below a superconductivity transition temperature and which are mounted in concentric rings of the circular closed loops on a heat sink disk.

30. Superconductive bearing apparatus comprising

a plurality of closed loops each formed of a superconductive material configured in a circular configuration and having zero electrical resistance at a temperature below a superconductivity transition temperature and which are mounted in concentric rings of small ones of the circular closed loops positioned between large ones of the circular closed loops on a heat sink disk.

31. Superconductive bearing apparatus comprising

a plurality of closed loops each formed of a superconductive

material configured in a circular configuration and having zero electrical resistance at a temperature below a superconductivity transition temperature and first ones of which are mounted in aligned rows and columns and second ones of which are mounted in aligned rows and columns and positioned in-between the first closed loops.

32. Superconductive bearing apparatus comprising

a plurality of closed loops each formed of a superconductive material configured in a square configuration and having zero electrical resistance at a temperature below a superconductivity transition temperature and first ones of which are mounted as a square mesh on an upper surface of a first heat sink and second ones of which are mounted as a square mesh on an upper surface of a second heat sink and mounted such that the second closed loops are positioned adjacent a lower surface of the first heat sink to correspond with the first closed loops.

33. A method of supporting a rotor within a stator by magnetic bearings comprising the steps of

arresting the rotor having closed rotor loops with respect to the stator having closed stator loops adjacent the closed rotor loops wherein the closed loops are formed of a superconductive material,

cooling the rotor and stator closed loops to a temperature below a superconductivity transition temperature and establishing a zero electric resistance of the closed loops,

energizing the closed loops and establishing a frozen magnetic linkage mode between the rotor and stator closed loops, and

freeing the rotor and enabling the rotor to rotate in an equilibrium stable state within the stator.

34. The method of claim 33 wherein the energizing step comprises the step of

enabling the cooled rotor and the stator closed loops to assume a

resistance state.

35. The method of claim 34 wherein the energizing step comprises the step of

applying a current around a small part of the cooled rotor and stator closed loops to generate frozen magnetic linkages between the rotor and stator closed loops.

36. The method of claim 35 further comprising the step of

registering linear shifts and angular declinations of the rotating rotor with respect relative to the stator.

Abstract of the Invention

A method and apparatus for supporting a rotor in a free state with respect to a stator with superconducting bearings. The apparatus has a rotor with closed rotor loops mounted on the rotor shaft and which are formed of a material having zero electrical resistance at a temperature below a superconductivity transition temperature. A stator encloses the rotor and has closed stator loops formed of the zero electrical resistance material and angularly positioned on the stator about the closed rotor loops. The closed rotor and stator loops are cooled to a temperature below the superconductivity transition temperature of the loop material and energized to create a magnetic flux between the ones of the closed rotor and stator loops. Apparatus for centering and securing the rotor within the stator is released to enable the rotor to move in the free state with respect to the stator.

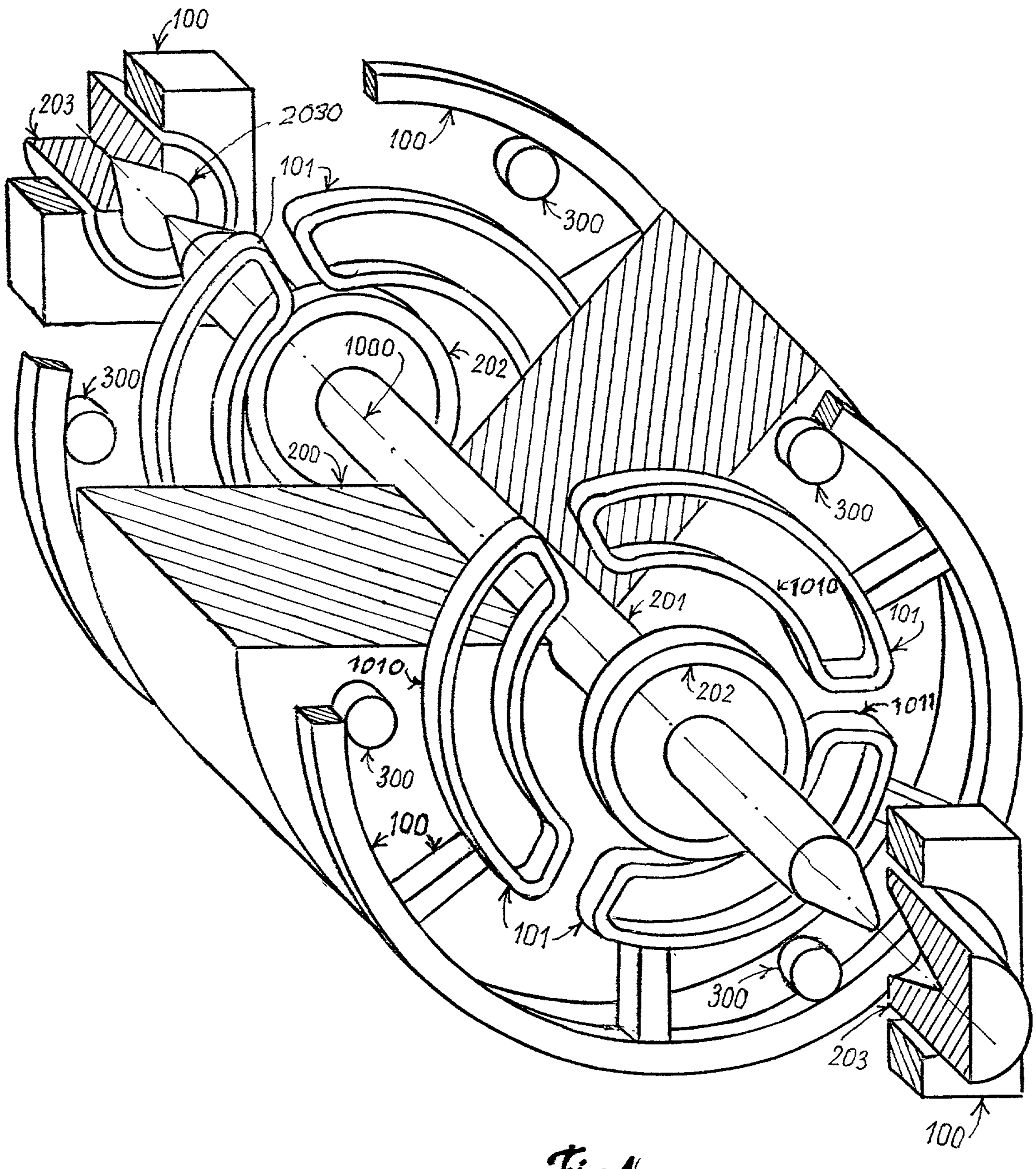
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Fig.1

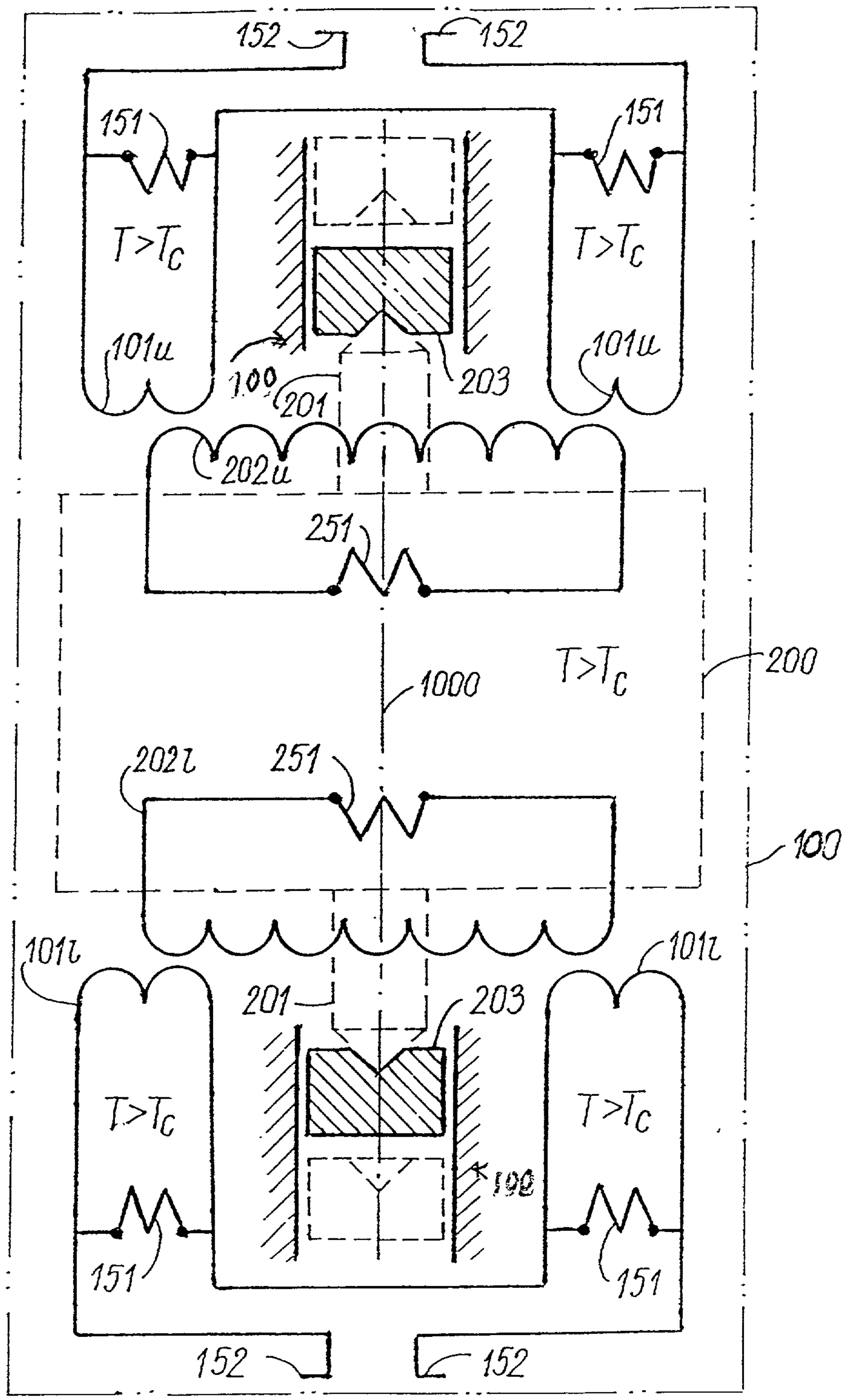

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Fig. 2

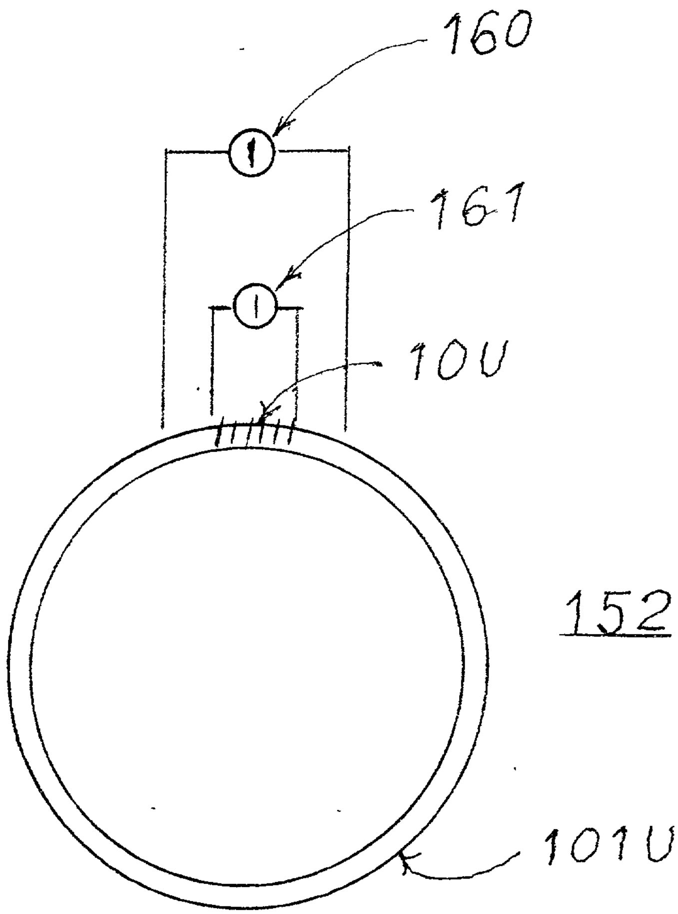

Fig. 3

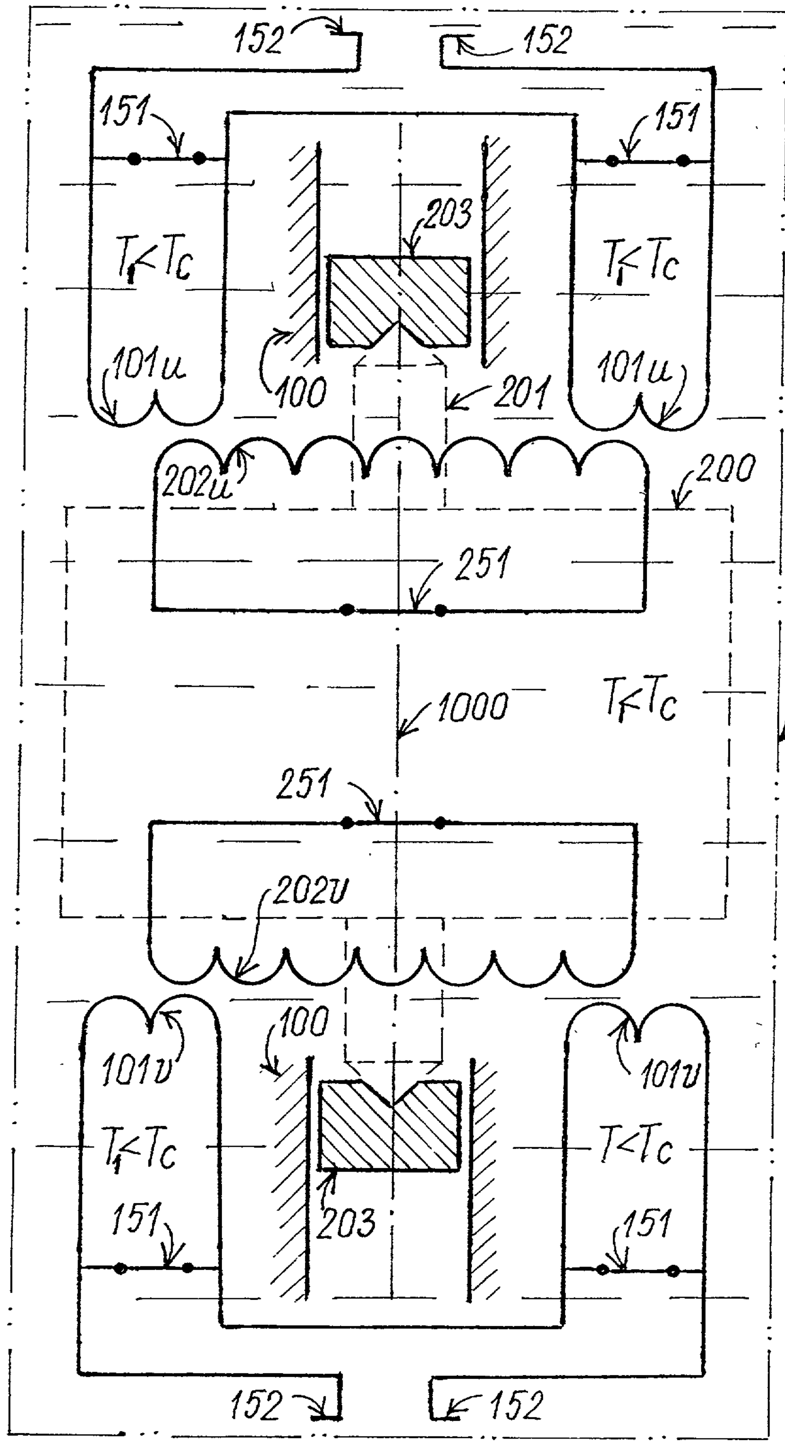
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Fig. 4

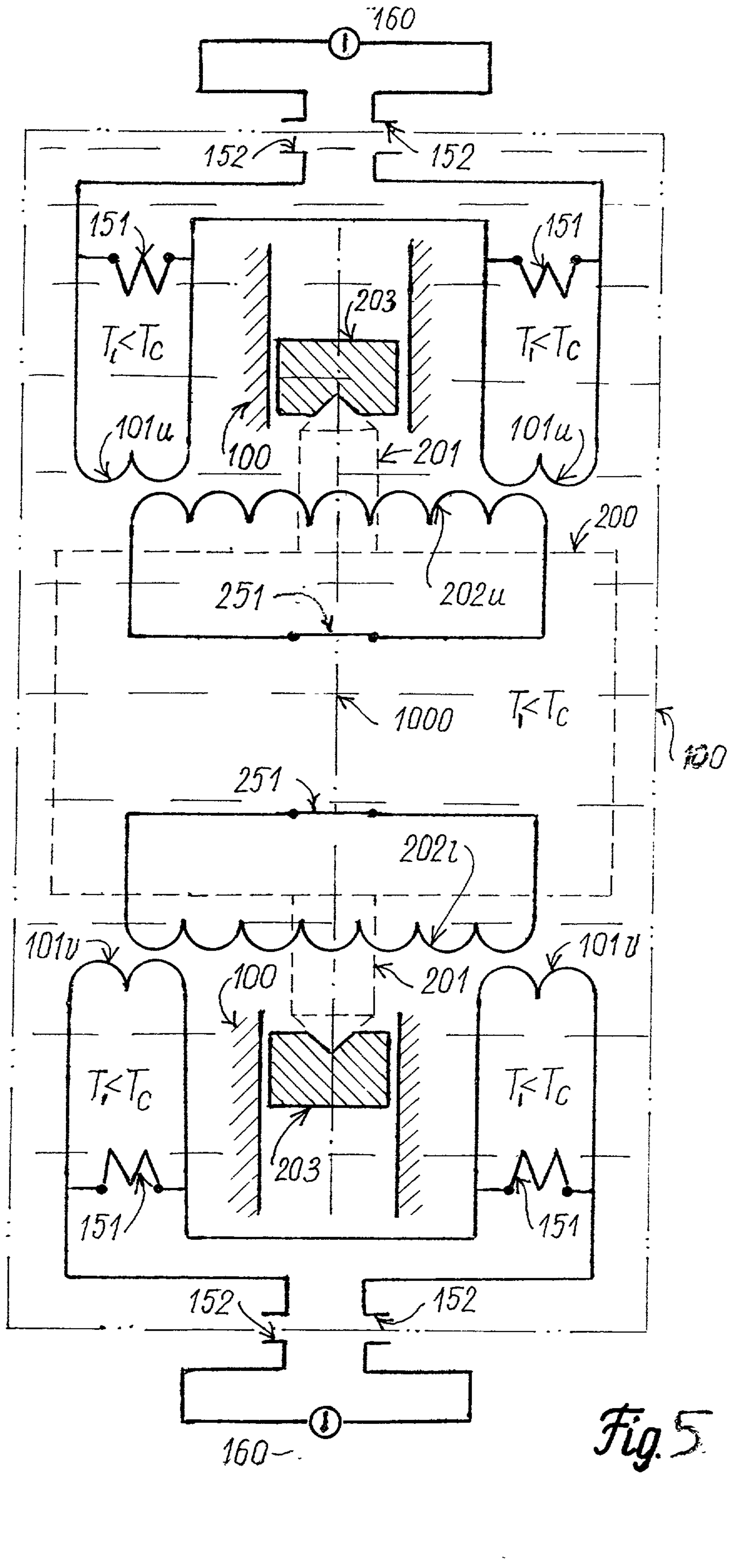

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Fig. 5

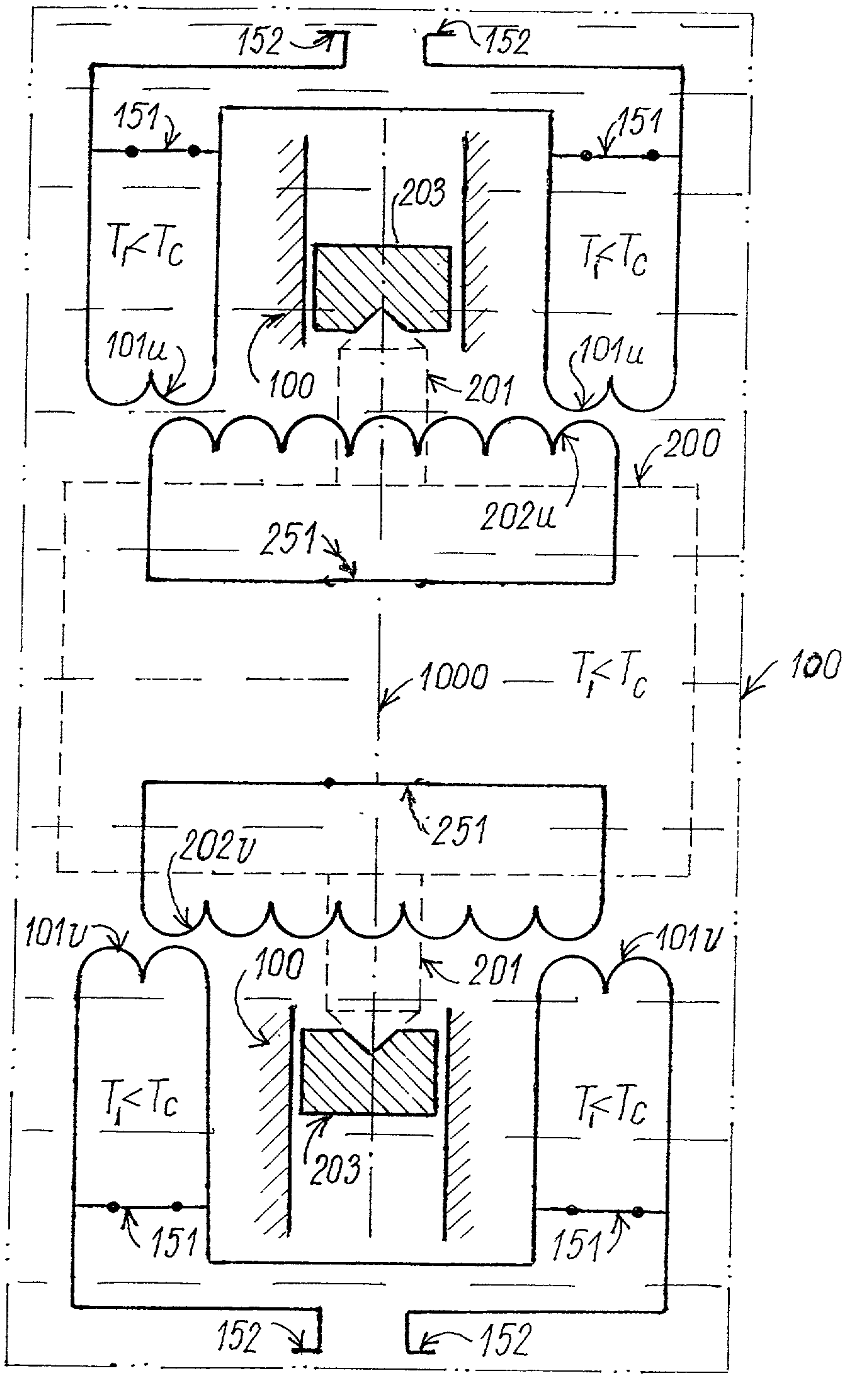
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Fig. 6

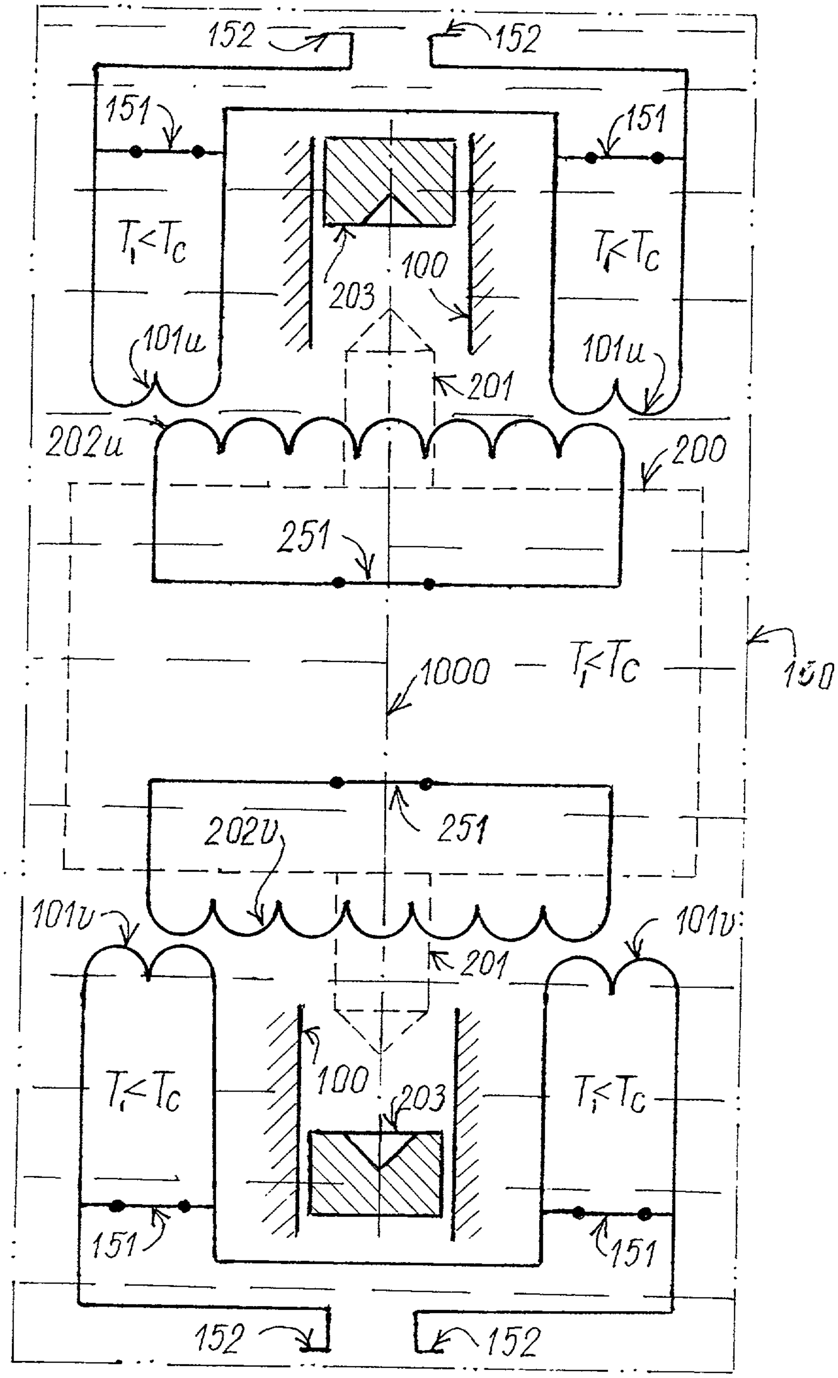
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Fig. 7

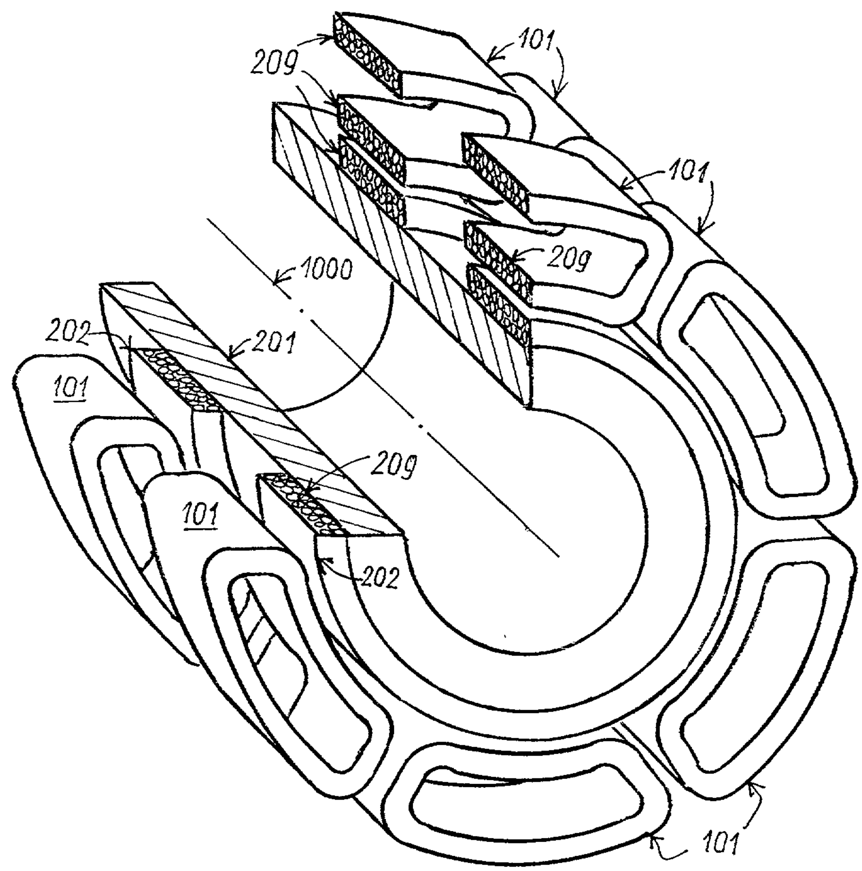


Fig 8

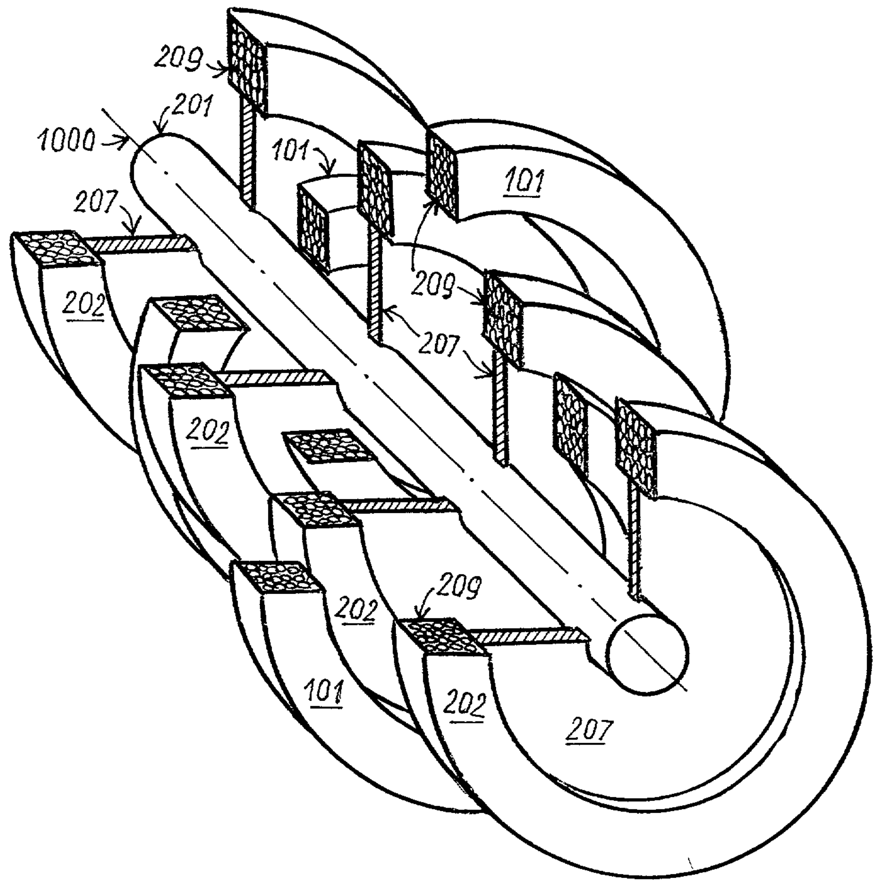


Fig.9

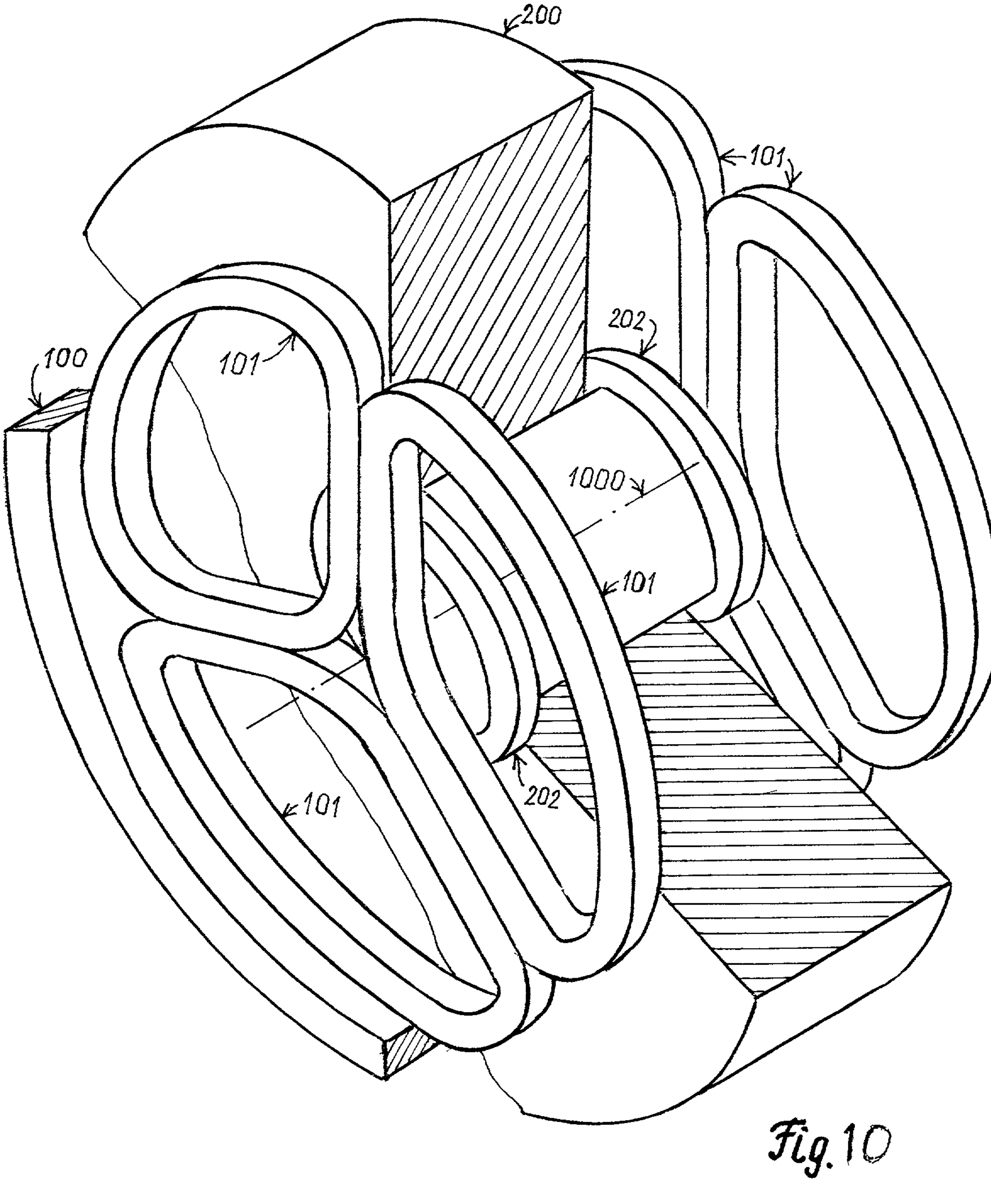


Fig.10

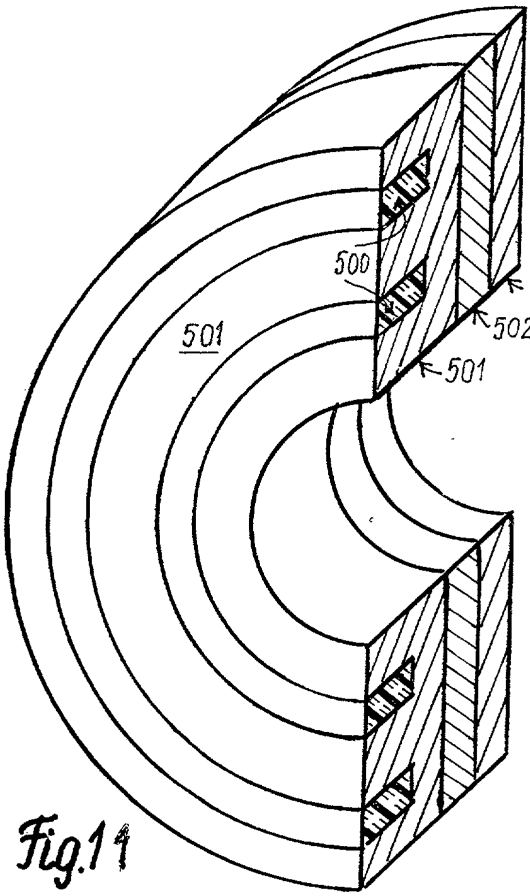


Fig.11

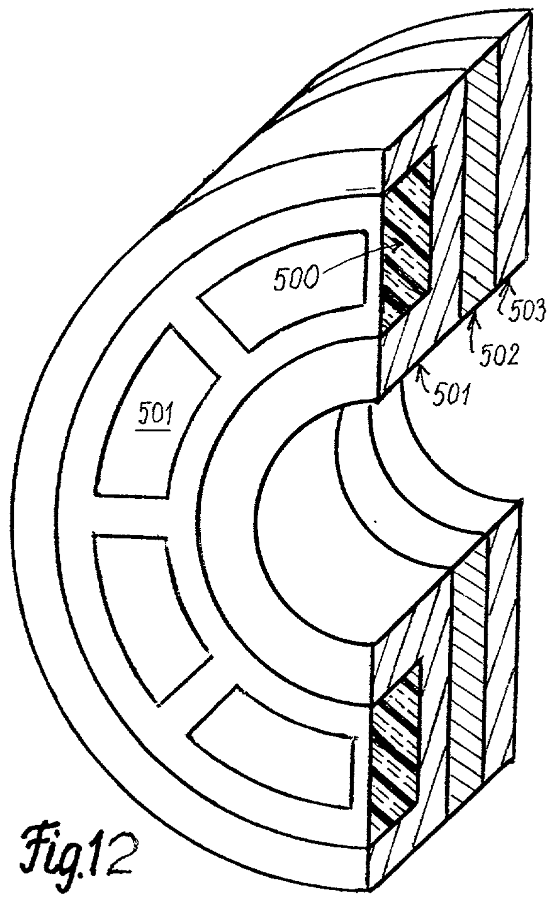
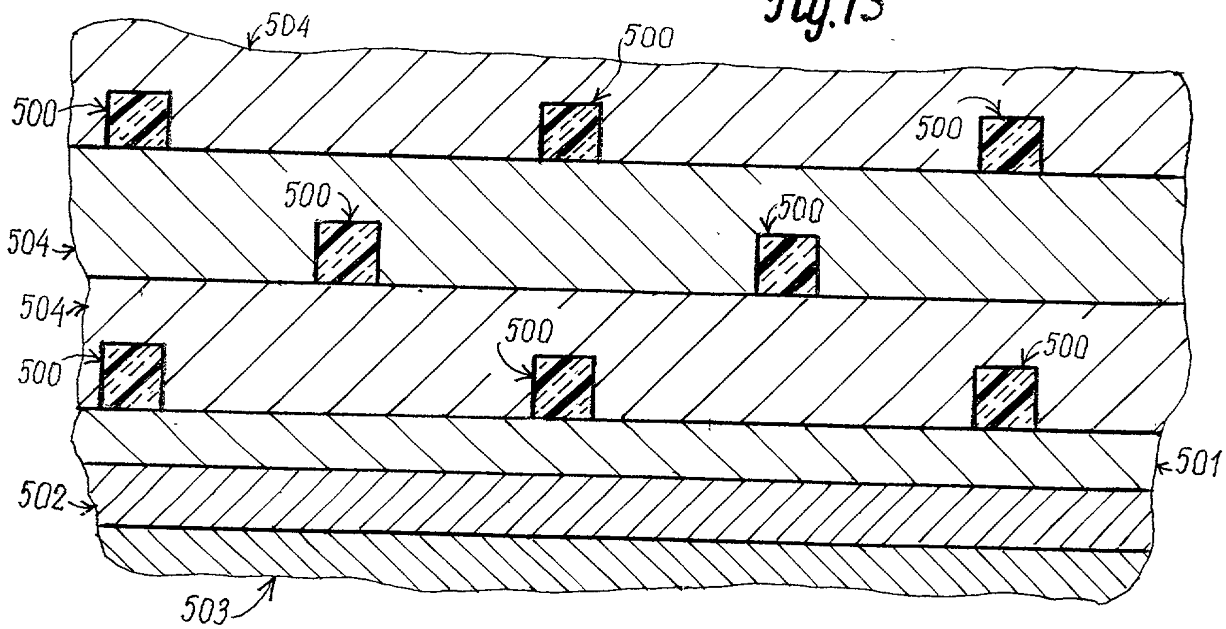


Fig.12

Fig.13



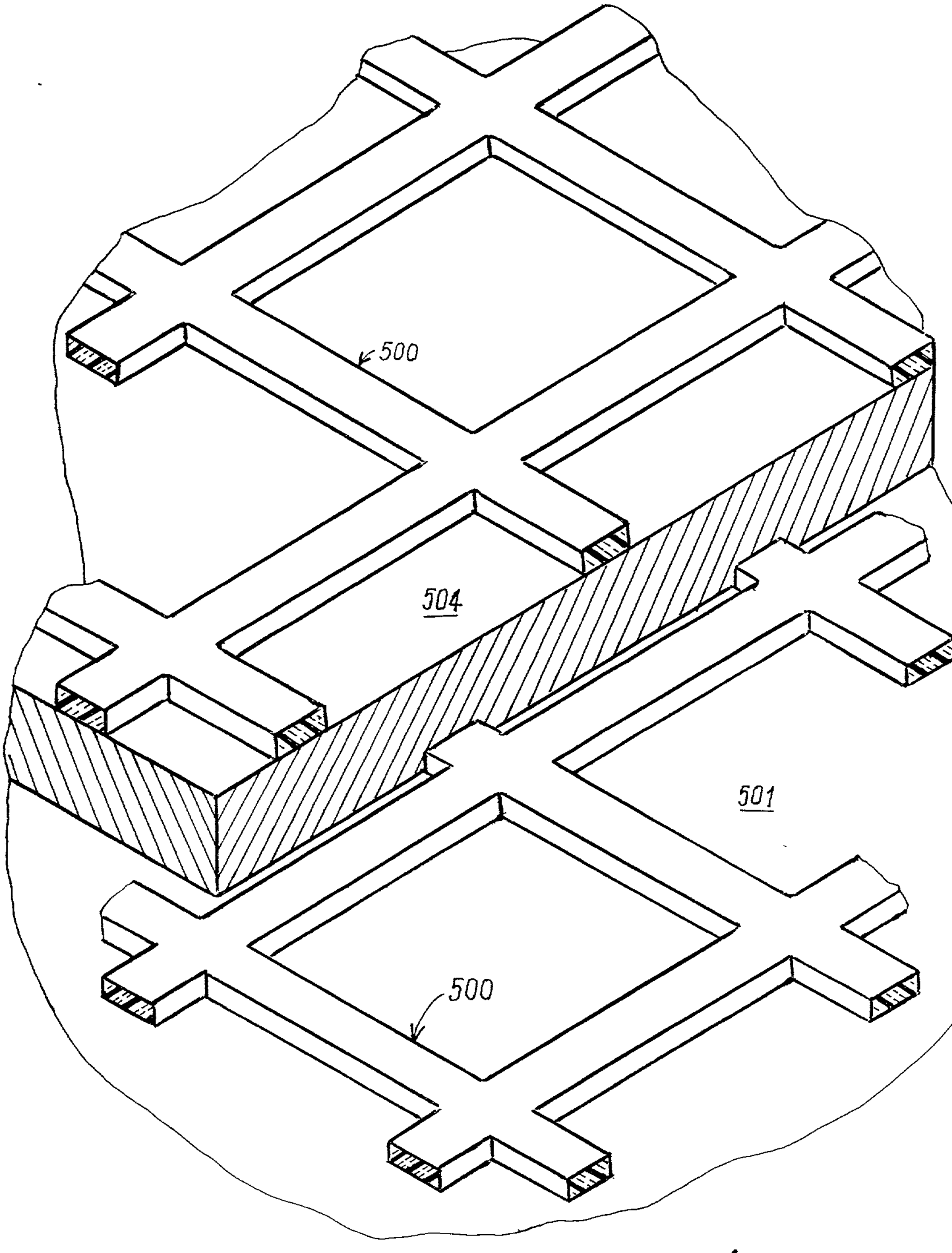


Fig.14

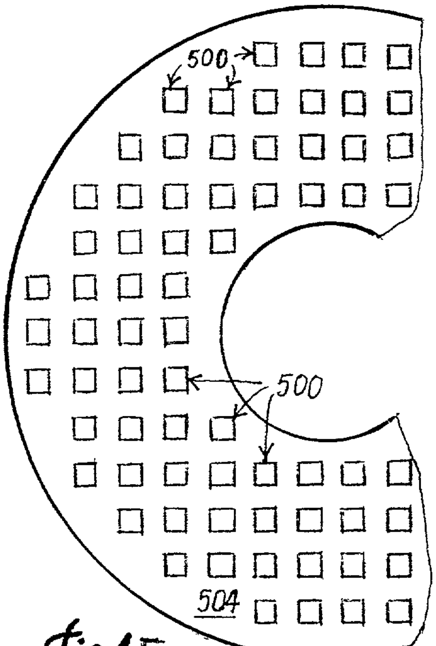


Fig.15

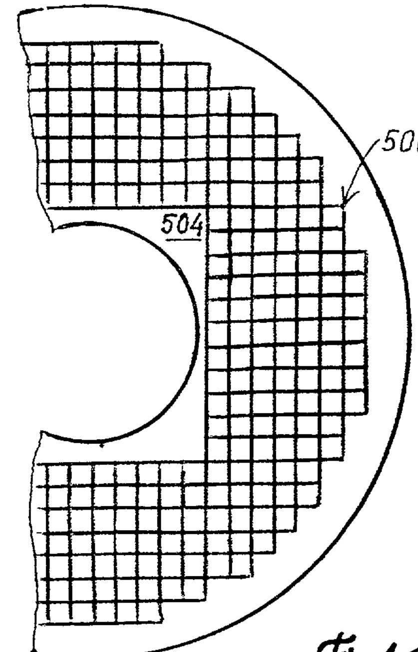


Fig.16

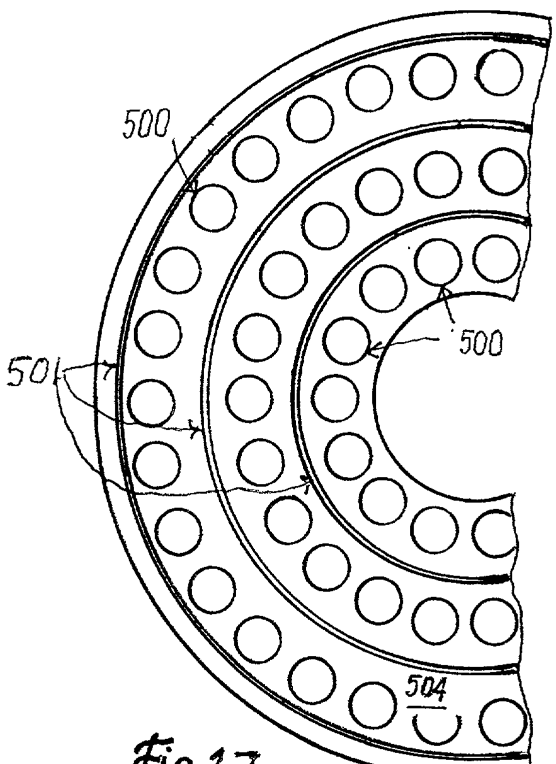


Fig.17

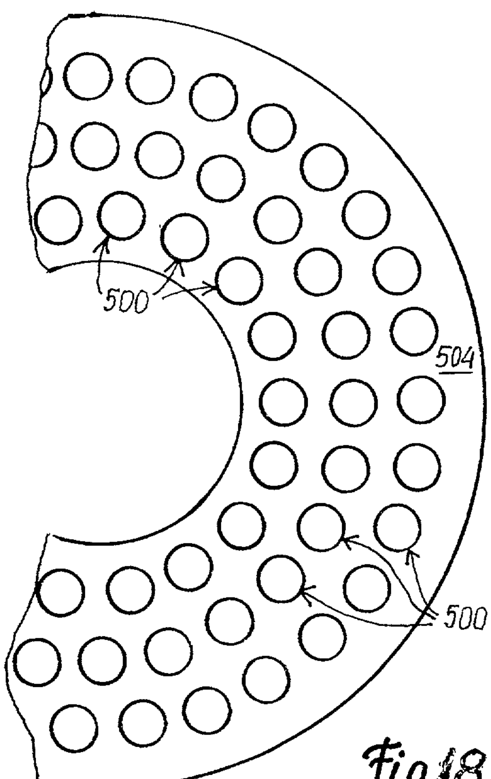


Fig.18

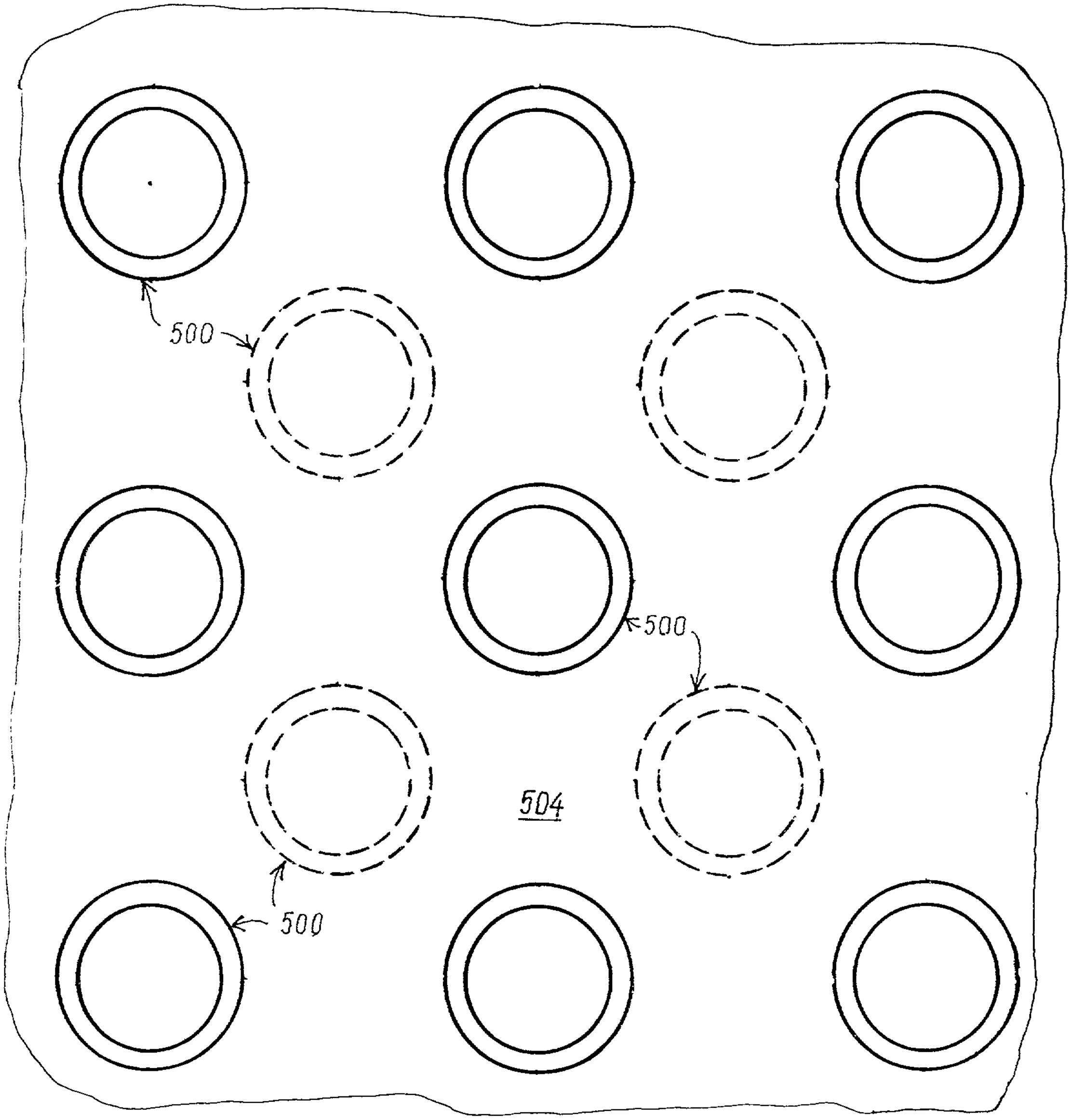


Fig. 19

**IN THE UNITED STATES
PATENT AND TRADEMARK OFFICE**

Declaration and Power of Attorney

As the below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled Super Conductive Bearing the specification of which is attached hereto.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by an amendment, if any, specifically referred to in this oath or declaration.

I acknowledge the duty to disclose all information known to me which is material to patentability as defined in Title 37, Code of Federal Regulations, 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

None

I hereby claim the benefit under Title 35, United States Code, 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, 112, I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

None

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

I hereby appoint the following attorney with full power of substitution and revocation, to prosecute said application, to make alterations and amendments therein, to receive the patent, and to transact all business in the Patent and Trademark Office connected therewith:

Dwight A. Marshall (Reg. No. 25896)

Please address all correspondence to Dwight A. Marshall, 1159 Blind Brook Dr., Worthington, Ohio 43235-1206. Telephone calls should be made to Dwight A. Marshall by dialing Area Code 614-888-6533.

Full name of sole inventor: Vasyl' V. Kozoriz

Walter Reiner

Inventor's signature for Vasyl' V. Kozoriz Date AUG 29 2000

Residence: 5 Poljarna Street
Kyjv (Kiev), 201Ukraine

Citizenship: Ukrainian

Post Office Address: 5 Poljarna Street
Kyjv (Kiev), 201 Ukraine

SIGNATURE BY PERSON WITH SUFICIENT PROPRIETARY INTEREST ON BEHALF OF NONSIGNING INVENTOR WHO CANNOT BE REACHED (37 CFR 1.47(B))

I, Walter Reiner, hereby declare that I am a citizen of the United States of America residing at 9409 Walnut Hull Dr., Genoa Township, Westerville, Ohio, 43082 and that I am the owner of my company, Global Trading & Technology, Inc., 5030 Westerville Road, Columbus, OH, 43231, assignee having sufficient proprietary interest in the aforementioned invention entitled Super Conductive Bearing.

By virtue of this proprietary interest, I sign this declaration on behalf of, and as agent for:

Vasyl' V. Kozoriz
5 Poljarna Street, Apartment 99
Kyiv (Kiev) 201, Ukraine

nonsigning inventor who is a citizen of the Ukraine and whose last known address was 3399 Partridge Place, Apartment 203, County of Franklin, Columbus, Ohio 43231 and after being located with due diligence, refused to sign the papers required for the filing of a patent application for an invention duly assigned by contract to assignee, Global Trading & Technology, Inc.

Upon information and belief, I aver those facts that the inventor is required to state, 37 CFR 1.64(b).

I, further state that in accordance with 37 CFR 1.47(b) that the inventor, Vasyl' V. Kozoriz, has assigned in writing in accordance with a duly written and executed contract with Global Trading & Trading, Inc., 5030 Westerville, Ohio, 43231, a copy of which is included with this application for recording in the U.S. patent and Trademark Office, a proprietary interest to the above set forth invention to Global Trading & Technology, Inc. which I own.

Walter Reiner

Walter Reiner, Owner
Global Trading & Technology, Inc.

AUG 29 2000

Date